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Titanium dioxide (TiO_2) receives a lot of attention in the context of hydrogen production by photocatalytic water splitting, where TiO_2 can be used as a layer protecting silicon photocathodes. For this application, the TiO_2 material is synthesized by the physical vapor deposition (PVD) in form of thin films. Our work focuses on a comprehensive characterization and description of compositional, morphological, and crystallographic aspects of such TiO_x deposits grown on Si <001> by reactive DC magnetron sputtering from a metal titanium (Ti) target in Ar/O_2 gas mixture.

Characterization of the TiO_x thin film on a μm-mm scale by means of Rutherford backscattering spectrometry (RBS) and grazing incidence X-ray diffraction (GIXRD) shows that the film is close to a stoichiometric compound, i.e. TiO_2, composed of two crystallographic phases, i.e. rutile and anatase. In order to follow the structure and the spatial distribution of the crystallographic phases on the sub-μm level electron scattering, i.e. transmission electron microscopy (TEM) and electron diffraction (ED) is used. TEM and ED are performed on thin focused ion beam (FIB) milled lamellas prepared in the direction parallel and perpendicular to the direction of the TiO_2 film growth.